OVER-VOLTAGE PROTECTION OF INTEGRATED CIRCUIT I/O PINS

ABSTRACT

Circuits, methods, and apparatus for protecting devices in an output stage from over-voltage conditions caused by high supply and input voltages. Embodiments provide over-voltage protection that operates over a range of voltage levels, and that can be optimized for performance at different voltage levels. An exemplary embodiment of the present invention uses stacked devices to protect n and p-channel output devices from excess supply and input voltages. These stacked devices are biased by voltages received at their gates. These gate voltages vary as a function of supply voltage to maintain performance. Other embodiments of the present invention provide a body bias switch that generates a bias for the bulk of p-channel output devices. This bias tracks the higher of a supply or input voltage, such that parasitic drain-to-bulk diodes do not conduct. A switch may be provided that shorts the bulk connection to VCC under appropriate conditions.